

August 6, 2001

INFORMATION DISCLOSURE STATEMENT letter

To Whom it May Concern:

The following documents are included in form PTO/SB/08A Information Disclosure Statement by Applicant as a bibliography for the application having the following title and applicant.

Title: Symbol Constellations Having Second-Order Statistics with Cyclostationary Phase

Applicant: Charles D. Murphy

Here, the documents are discussed as they relate to the specification and claims of the application.

The following three documents (Serpedin and Giannakis 1998, Giannakis 1997, and Tsatsanis and Giannakis 1997) relate to transmitter-induced cyclostationarity. The main focus of these papers is on conjugated second moments that are cyclostationary. The principal ways of introducing such cyclostationarity are by modulating the power of transmitted symbol constellations and by coding to introduce correlation between successive symbols. Conjugated second moments always have a phase of zero, which is not the case in the invention of the application. The paper (Serpedin and Giannakis 1998) has a very brief mention of using non-conjugated second moments. The differences between the invention of the application and the work in (Serpedin and Giannakis 1998) are discussed in the application. Note that there are other papers in the technical literature on transmitter-induced cyclostationarity.

E. Serpedin and G.B. Giannakis, "Blind Channel Identification and Equalization with Modulation-Induced Cyclostationarity," IEEE Transactions on Signal Processing, Vol. 46, No. 7, pp. 1930-1944, July 1998.

G.B. Giannakis, "Filterbanks for Blind Channel Identification and Equalization," IEEE Signal Processing Letters, Vol. 4, No. 6, pp. 184-187, June 1997.

M.K. Tsatsanis and G.B. Giannakis, "Transmitter Induced Cyclostationarity for Blind Channel Equalization," IEEE Transactions on Signal Processing, Vol. 45, No. 7, pp. 1785-1794, July 1997.

The following three documents (Hatzinakos and Nikias 1994, Tong, Xu, and Kailath 1994, and Papadias and Slock 1999) discuss blind identification and equalization of linear channels using higher-order statistics (Hatzinakos and Nikias 1994) and using fractional sampling (Tong, Xu, and Kailath 1994, and Papadias and Slock 1999). There are many other papers in the literature that discuss advantages and drawbacks of higher-order statistics and fractional sampling in channel identification and equalization.



D. Hatzinakos and C.L. Nikias, "Blind Equalization Based on Higher-Order Statistics (H.O.S.)," Blind Deconvolution, S. Haykin (ed.), Englewood Cliffs: PTR Prentice Hall, 1994.

L. Tong, G. Xu, and T. Kailath, "Blind Identification and Equalization Based on Second-Order Statistics: A Time Domain Approach," IEEE Transactions on Information Theory, Vol. 40, No. 2, pp. 340-349, March 1994.

C.B. Papadias and D.T.M. Slock, "Fractionally Spaced Equalization of Linear Polyphase Channels and Related Blind Techniques based on Multichannel Linear Prediction," IEEE Transactions on Signal Processing, Vol. 47, No. 3, pp. 641-654, March 1999.

The following two papers (Furuskar, Mazur, Muller, and Olofsson 1999 and Boss, Kammeyer, and Petermann 1998) discuss channel equalization in packet-based wireless communications. The papers examine channel variation with time, training-based equalization, and the possibilities of recovering training symbol slots for use in sending data when blind or semi-blind channel equalization is used. The material in these papers motivates using the invention of the application in actual systems such as mobile phone networks and also describes some of the problems that must be solved in order to do so.

A. Furuskar, S. Mazur, F. Muller, and H. Olofsson, "EDGE: Enhanced Data Rates for GSM and TDMA/136 Evolution," IEEE Personal Communications, Vol. 6, No. 3, pp. 56-66, June 1999.

D. Boss, K.-D. Kammeyer, and T. Petermann, "Is Blind Channel Estimation Feasible in Mobile Communication Systems? A Study Based on GSM," IEEE Journal on Selected Areas in Communications, Vol. 16, No. 8, pp. 1479-1492, October 1998.

The following two books (Proakis 1995 and Freeman 1998) are general textbooks on digital communications techniques. They describe channel modeling, channel identification and equalization, common symbol constellations, and various other communications issues.

J.G. Proakis, Digital Communications, New York: McGraw-Hill, 1995.

R.L. Freeman, Telecommunications Transmission Handbook, 4th Ed., New York: John Wiley & Sons 1998.

The following book (Gardner 1994) discusses in great detail cyclostationarity and its applications in practical areas such as digital communications and other types of signal processing.

W.A. Gardner (ed.), Cyclostationarity in Communications and Signal Processing, New York: IEEE Press, 1994.

The following book (Bendat 1990) discusses the identification of nonlinear systems using random data. The book relates to seismic signal processing, acoustic signal processing, and also to digital communications for certain types of nonlinear channel models.

J.S. Bendat, *Nonlinear System Analysis and Identification from Random Data*, New York: John Wiley and Sons, 1990.

The following three papers (Sato 1975, Godard 1980, and Treichler and Agee 1983) are early works on blind equalization techniques that make implicit use of higher-order statistics. There are many more-recent papers which investigate the shortcomings of these techniques and recommend various improvements.

Y. Sato, "A Method of Self-Recovering Equalization for Multilevel Amplitude-Modulation Systems," *IEEE Transactions on Communications*, Vol. COM-23, pp.679-682, June 1975.

D.N. Godard, "Self-Recovering Equalization and Carrier Tracking in Two-Dimensional Data Communication Systems," *IEEE Transactions on Communications*, Vol. COM-28, pp. 1867-1875, November 1980.

J.R. Treichler and B.G. Agee, "A New Approach to Multipath Correction of Constant-Modulus Signals," *IEEE Trans. on Acoustics, Speech, and Signal Processing*, Vol. 31, No. 2, pp. 459-471, April 1983.

The following two papers (Gomes and Barroso 1997 and Theodoridis, Cowan, Callender, and See 1995) discuss some nonlinear channel equalizers, with (Cowan, Callender, and See 1995) investigating equalization of nonlinear channels. There are many other papers on training-based equalization of nonlinear channels and nonlinear equalization of linear channels.

J. Gomes and V. Barroso, "Using an RBF Network for Blind Equalization: Design and Performance Evaluation," *Proceedings of ICASSP '97*, 1997, pp. 3285-3288.

S. Theodoridis, C.F.N. Cowan, C.P. Callender, and C.M.S. See, "Schemes for Equalisation of Communication Channels with Nonlinear Impairments," *IEEE Proceedings on Communications*, Vol. 142, No. 3, pp. 165-171, June 1995.

The following paper (Saleh 1981) contains a study of the amplification characteristics of traveling-wave tube amplifiers. The author develops a model of traveling-wave tube amplifier nonlinearity that consists of a memoryless amplitude nonlinearity and a memoryless phase nonlinearity both of which are functions of input amplitude. Many subsequent papers have used this model, particularly in satellite communications where traveling-wave tube amplifiers are used.

A.M. Saleh, "Frequency Independent and Frequency Dependent Nonlinear Models of TWT Amplifiers," *IEEE Transactions on Communications*, Vol. COM-29, pp. 1715-1720, November 1981.

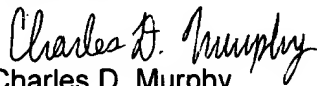
The following paper (Dardari, Tralli, and Vaccari 1998) contains a model of a solid-state power amplifier nonlinearity. The saturation of power amplifiers near their power supply limits is a topic of many other papers, and development of highly linear power amplifiers is the subject of a great deal of analog circuit design work.

D. Dardari, V. Tralli, and A. Vaccari, "A Novel Low Complexity Technique to Reduce Non-linear Distortion Effects in OFDM Systems," Proceedings of IEEE PIMRC '98, Boston, September 1998.

The patent (US patent 4,922,506) issued to McCallister and Shearer in 1990 contains a very broad independent method claim on using "a cyclostationary signal" in order "to estimate the transfer characteristics of [a] medium". In further claims and in the specification the patent indicates very clearly that the invention is intended as a matched filter to recover a baseband signal when a spread-spectrum modulation technique

This concludes this INFORMATION DISCLOSURE STATEMENT letter.

Sincerely,

  
Charles D. Murphy

1816 West Wilson Avenue #3  
Chicago, IL 60640

Please type a plus sign (+) inside this box →

PTO/SB/08A (08-00)  
Approved for use through 10/31/2002, OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>			<b>Complete if Known</b>		
			Application Number		
			Filing Date		
			First Named Inventor	Charles D. Murphy	
			Group Art Unit		
			Examiner Name		
Sheet	1	of	3	Attorney Docket Number	

[illegible][illegible]

Examiner Signature		Date Considered	
-----------------------	--	--------------------	--

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Unique citation designation number. <sup>2</sup> See attached Kinds of U.S. Patent Documents. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

**Burden Hour Statement:** This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U. S. Patent and Trademark Office, Washington, DC 20231. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.**

Please type a plus sign (+) inside this box → ☐

PTO/SB/08B (08-00)

Approved for use through 10/31/2002. OMB 0651-0031  
U. S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449B/PTO		<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)		Application Number	
		Filing Date	
		First Named Inventor	
		Group Art Unit	
		Examiner Name	
		Attorney Docket Number	
Sheet	2	of	3

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
Examiner Initials <sup>1</sup>	Cite No. <sup>1</sup>	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T <sup>2</sup>
		E. SERPEDIN + G.B. GIANNAKIS, "Blind Channel Identification with Modulation-Induced Cyclostationarity" IEEE Trans. on Signal Processing, Vol. 46, No. 7, pp. 1930-1944, July 1998.	
		G.B. GIANNAKIS, "Filterbanks for Blind Channel Identification and Equalization," IEEE Signal Processing Letters, Vol. 4, No. 6, pp. 184-187, June 1997	
		MY TSATSANIS + GB GIANNAKIS, "Transmitter Induced Cyclostationarity for Blind Channel Equalization," IEEE Trans. on Signal Processing, Vol. 45, No. 7, pp. 1785-1794, July 1997.	
		D. MATZINAKOS and G. NIKIAS, "Blind Equalization Based on Higher-Order Statistics (HOS)," in Blind Deconvolution, ed. S. Haykin, Englewood Cliffs: PTR Prentice Hall 1994.	
		L. TONG, G. XU, and T. KATLATH, "Blind Identification and Equalization Based on Second-Order Statistics: A Time Domain Approach" IEEE Trans. on Information Theory, Vol. 40, No. 2, pp. 340-349, March 1994	
		CB PAPAGEORGIS + DTM SLOCK, "Fractionally Spaced Equalization of Linear Polyphase Channels and Related Blind Techniques based on Multichannel Linear Prediction," IEEE Trans. on Signal Processing, Vol. 47, No. 3, pp. 641-654, March 1999.	
		A. FURUSKAR, S. MAZUR, F. MULLER, and H. OLOFSSON, "EDGE: Enhanced Data Rates for GSM and TDMA/ISG Evolution," IEEE Personal Communications, Vol. 6, No. 3, pp. 56-66, June 1999	
		D. BOSS, K.D. KAMMAYER, and T.P. PETERMANN, "Is Blind Channel Estimation Feasible in Mobile Communication Systems? A Study Based on GSM," IEEE Journal on Selected Areas in Communications, Vol. 16, No. 8, pp. 1474-1492, October 1998.	
		J.G. PROAKIS, "Digital Communications," New York: McGraw Hill, 1995	
		R.L. FREEMAN, "Telecommunications Transmission Handbook," 4th edition, New York: John Wiley & Sons, 1998.	
		W.A. GARDNER (Editor) "Cyclostationarity in Communications and Signal Processing," New York: IEEE Press, 1994.	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Unique citation designation number. <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U. S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Please type a plus sign (+) inside this box → ☐

PTO/SB/08B (08-00)  
Approved for use through 10/31/2002. OMB 0651-0031

U. S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449B/PTO		<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)		Application Number	
		Filing Date	
		First Named Inventor	
		Group Art Unit	
		Examiner Name	
		Attorney Docket Number	
Sheet	3	of	3

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
Examiner Initials <sup>1</sup>	Cite No. <sup>1</sup>	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T <sup>2</sup>
		OS BENDAT, "Nonlinear System Analysis and Identification from Random Data" New York: John Wiley & Sons, 1990.	
		Y. SATO, "A Method of Self-Recovering Equalization for Multilevel Amplitude Modulation Systems," IEEE Trans. on Communications, Vol. COM-23, pp. 679-682, June 1975.	
		D.N. GODARD, "Self-Recovering Equalization and Carrier Tracking in Two Dimensional Data Communication Systems," IEEE Trans. on Communications, Vol. COM-28, pp. 1867-1875 November 1980	
		J. TREICHLER & B. AGEE, "A New Approach to Multipath Correction of Constant-Modulus Signals," IEEE Trans. on Acoustics, Speech, & Signal Processing, Vol. 31, No 2, pp. 459-471, April 1983.	
		J. GOMES & V. BARROSO, "Using an RBF Network for Blind Equalization: Design and Performance Evaluation," Proceedings of ECASSP 1997, pp. 3285-3288.	
		S. THEODORIS, C.F. COWAN, C.P. CALLENDER, and C.M. SIE, "Schemes for Equalization of Communication Channels with Nonlinear Impairments," IEEE Proceedings on Communications, Vol. 142, No 3, pp. 165-171, June 1995.	
		A.M. SALEH, "Frequency Independent and Frequency Dependent Nonlinear Models of TWT Amplifiers," IEEE Trans. on Communications, Vol. COM-29, pp. 1715-1720, December 1981.	
		D. DARDARI, V. TRALLE, and A. VACCARE, "A Novel Low Complexity Technique to Reduce Nonlinear Distortion Effects in OFDM Systems," Proceedings of IEEE PIMRC 1998, September 1998.	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Unique citation designation number. <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U. S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.